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TITLE

WINTER-KILL OF THE BLACK HILLS BEETLE ON THE PIKE NATIONAL FOREST, COLORADO

By

J. A. Beal, Entomologist,

and

N. D. Wygant, Ass't. Entomologist

SUBJECT—

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Forest Insect Laboratory,
Fort Collins, Colorado,
February 8, 1939.

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In mid-January during a joint inspection of the spotting and control work being conducted on the Pike National Forest against the Black Hills beetle (Dendroctonus ponderosae Hopk.) considerable winter-kill was noted among some of the overwintering larvae.* Preliminary examination indicated that the mortality might be sufficiently heavy to permit some changes in control plans. It was therefore decided to make a more detailed examination of the infested areas in order to determine the extent and severity of the winter mortality among the larvae. Spotters Phillip Turner and Harold Werner were loaned for this work by the Forest Service and D. A. Hester, N. D. Wygant, and J. A. Beal of the Forest Insect Laboratory made up the rest of the crew. About 10 days were spent in sampling different areas on the Pike. During this time 89 infested ponderosa pine trees were felled, 680 samples 6 by 6 inches were taken, and 24,926 larvae observed for mortality. Weather records for the fall and winter months were checked at the Cheesman Lake station, the only official weather station within the area.

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* Prior to this trip M. W. Magelssen had observed and collected some dead larvae.

In order to determine the extent and severity of recently discovered brood mortality among larvae of the Black Hills beetle on the Pike National Forest a crew of five men spent most of two weeks collecting data on this subject. For the most part the trees examined were felled by the crew principally because this was found to be more satisfactory than depending upon CCC labor for this work as was originally planned. Samples 6 by 6 inches square were taken on both north and south sides of the trees at intervals of 5 feet from the lowest to the highest point of infestation. The number of dead and living larvae were recorded and measurements taken of the bark thickness and diameter of tree at each sample as well as height of sample on tree, aspect, and location.

The only effective low temperature as shown by the weather records at Cheesman Lake occurred on Nov. 6, 1938 when the minimum was -5° F. Critical low temperature studies of the Black Hills beetle larvae during three seasons in the laboratory at Fort Collins show that -5° F. killed 30 to 75 percent of the overwintering larvae at this time of year. These tests were made with larvae removed from the bark but under natural conditions the bark offers protection in proportion to its thickness. The tests were made with larvae from the north end of the Roosevelt National Forest and cold-hardiness probably had progressed further here than on the Pike. The cold-hardiness was rapidly increasing at the time the kill occurred on the Pike. The higher mortality which was found to occur on the south sides of the

trees is attributed to the fact that the cold-hardiness of the larvae had advanced less on that side than on the north side.

Careful counts were made on the brood in 622 quarter-foot samples on 68 infested ponderosa pine trees. In addition examinations were made on 21 trees including 58 quarter-foot samples where the mortality was estimated to the nearest five percent. The data on actual counts are tabulated according to side of tree, area, and bark thickness, and presented in the following table (Table I).

Table I.-Mortality of overwintering larvae of the Black Hills beetle - north and south sides of trees of all areas Pike National Forest

North Side

Bark thickness in inches	.2		.3		.4		.5		.6		.7		.8		.9		1.0		
Area	A*	D**	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	% dead
Upper Deer Creek	14	31	20	107	68	61	106	185	259	147	226	97	374	47	156	0	236	18	27
Estabrook	--	--	--	--	116	26	448	355	310	76	344	87	98	2	127	0	207	18	25
Shawnee	--	--	10	1	219	121	180	198	331	84	428	57	181	16	408	38	232	23	21
Bailey	--	--	32	2	117	28	451	231	181	62	198	15	89	2	13	0	74	3	23
Cheesman Lake	--	--	203	134	270	206	553	236	487	239	481	230	573	91	262	53	415	35	27
Totals	14	31	265	244	790	442	1738	1185	1568	608	1677	486	1315	158	966	91	1164	97	26
% mortality		69		48		36		41		28		23		11		9		8	

South Side

Upper Deer Creek	--	--	5	107	64	115	60	376	218	187	184	153	198	45	123	3	682	30	40
Estabrook	--	--	0	4	220	112	126	108	378	256	139	34	152	10	117	0	94	2	30
Shawnee	48	22	3	0	60	25	233	241	476	370	98	13	224	50	101	10	207	49	35
Bailey	--	--	--	--	67	19	135	45	228	81	258	108	24	39	--	--	272	14	24
Cheesman Lake	9	13	63	155	136	140	495	316	521	358	681	237	416	23	298	45	329	30	31
Totals	57	35	71	266	547	411	1049	1086	1821	1252	1360	545	1014	167	639	58	1584	125	33
% mortality		38		79		43		51		41		29		14		8		7	
% mortality North & south		48		60		40		45		35		25		12		8		7	
North & south Total mortality																			29

* A = live larvae
** D = dead larvae

It can be seen from the foregoing table that the mortality varied considerably not only by areas but also according to bark thickness and side of tree. Total mortality from the north side of all trees sampled varied from 69 percent in thin bark to 8 percent in the thicker bark and averaged 26 percent. From the south side it varied from 60 to 7 percent and averaged 33 percent. The average mortality from both sides was only 29 percent. In general winter-kill was heaviest under the thinner bark. In cases where this was not true such as in bark .2 inches in thickness it is definitely known that the number of samples were insufficient to give accurate results. Under bark .4 and .5 inches in thickness the reversal of the expected mortality is believed to be due to the fact that many of the thinner bark samples were taken from large, over-mature, smooth-barked trees with shallow crevices where measurements on bark thickness are easily made while many of the others were taken from very irregular bark with deep crevices on small trees.

Although individual samples sometimes showed mortality approaching 100 percent it was not found sufficiently high in any one area to greatly affect the present control program. About the only thing to be gained from the freeze is the fact that practically no survival occurred in the limbs and therefore it will no longer be necessary to treat them.

The percent mortality for all areas including two in Lake George where estimates only were made is given in the following table (Table II).

Table II.-Percent mortality of overwintering larvae of the Black Hills beetle on the Pike N. F.

Area	No. of trees	No. of samples	Bark thickness in inches and percent mortality									Total mortality
			.2	.3	.4	.5	.6	.7	.8	.9	1.0	
Upper Deer Creek	13	112	69	90	57	77	41	34	13	1	5	36
Estabrook	10	98	--	100	29	44	33	20	5	0	6	27
Shawnee	15	133	31	7	34	52	36	12	14	9	14	38
Bailey	7	54	--	6	20	32	26	21	27	0	5	23
Cheesman Lake	23	225	60	52	46	35	37	29	10	15	8	29
North end Lake George	11	43	20	15	25	5	5	0	--	--	0	10
South end Lake George	10	15	--	65	55	50	45	30	0	--	--	40
Average *	89	680	48	60	40	45	35	25	12	8	7	29

* Weighted average exclusive of Lake George areas where estimates rather than actual counts were made.

The percent mortality of overwintering larvae of the Black Hills beetle on the Pike National Forest is given by areas and by bark thickness. Obviously the winter-kill was not complete in any area nor under even the thinnest bark measured. It is also apparent that in some cases the samples are inadequate in number. Mortality in different areas varies from as high as 40 percent to as low as 10 percent and it should be noted that these two extremes occur in the Lake George area where only rough estimates were made. In other areas it varies from 23 percent in the Bailey area to 38 percent in the Shawnee area, two closely associated localities. The other areas with mortality ratings are: Deer Creek with 36 percent, Estabrook with 27 percent, and Cheesman Lake with 29 percent. Mortality for all areas when weighed according to the number of larvae was only 29 percent. Since figures are not available on the relative abundance of bark of different thicknesses this is the most accurate estimate available. However since samples were well distributed in bark of different thicknesses it is believed to be fairly close.

The relation of the winter mortality to bark thickness and side of tree is most clearly shown in Chart 1. The curves have been smoothed to show what is believed to be the true picture of the kill under bark of various thicknesses. The red line indicates larval mortality according to bark thickness on the south side of all trees. The green line indicates larval mortality according to bark thickness on the north side of all trees. The black line represents the average mortality on both south and north sides of the trees.

Although no detailed counts were made many of the larger limbs were examined and practically no living larvae were found in them.

SUMMARY

A sudden drop in temperature to -5° F. on November 6 resulted in considerable mortality of overwintering larvae of the Black Hills beetle in ponderosa pine on the Pike National Forest in central Colorado. This freeze apparently occurred before winter hardiness of the larvae had progressed far enough to give them adequate protection from unseasonal low temperatures.

Larval mortality varied in the seven areas examined from as low as 10 percent to as high as 40 percent with an average of 29 percent. Great variation often occurred within trees in the same area. In general mortality varied indirectly with the bark thickness, the mortality under the thinner bark occasionally being as high as 100 percent while with bark of an inch or more in thickness practically no mortality occurred.

Brood mortality was consistently found to be higher on the south side of the trees than on the north side. Over all areas it averaged 33 and 26 percent respectively with a total average kill of 29 percent.

Mortality was not found to be high enough to permit any drastic changes in the present control program on the Pike. The only practical advantage of the freeze lies in the fact that the limbs will no longer have to be treated because practically all of the insects in them were killed by the low temperature.

Fort Collins, Colo.,
Feb. 8, 1939.

Respectfully submitted,

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Chart 1. - Relation of winter mortality to bark thickness